Space Weather Technical Forecast

Issued on Sunday, 30 April 2023 at 01:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2 throughout. Active electron fluence expected. Slight chance of G1, mainly day 3 (2 May).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has been Low, with occasional C-class flares, mostly from AR3288. The largest flare a C8.8 at 29/1017UTC. There are currently five numbered sunspot regions on the visible disc. The largest and most complex region on the disc remains AR3288 (Eso/Beta-Gamma), located in the southwest quadrant. The previous delta configuration appears to have faded since the last analysis, however further evolution is evident in the intermediate spots. In close proximity to the north is AR3285 (Cao/Beta) which may also help to increase magnetic instability. AR3289 (Dsi/Beta-Gamma) has seen continued slight growth in its northern spots. This region has more of a north-south magnetic alignment, which could increase the instability of this group. The other two numbered regions are small and more simple at present.

There have been numerous mainly weak and faint eruptions appearing in coronagraph imagery in the last 24 hours. Generally speaking, any CMEs are considered most likely to miss Earth, although some glancing influence from several different sources cannot be ruled out in the coming days. As a result, the forecast should be considered of lower than average confidence at present. Meanwhile, an eruption which occurred at 29/0400 UTC (and associated dimming) near the vicinity of AR3288, produced a CME, although there is no evidence of a filament near this region. This CME was modelled with the northern flank perhaps glancing Earth later on day 3 (2 May).

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE and DSCOVR at L1, was reflective of continuing fast wind enhancement from CH96/-. The wind speed has been at mostly Strong levels, mainly between 580-720km/s, declining a little to Elevated levels in recent hours. Density was below average. The IMF, Bt, was weak at 5-6nT, with the north-south component, Bz, mostly weakly southward directed between +5 to -6 nT. The phi angle has been mostly negative (towards the Sun). Geomagnetic activity was predominantly Unsettled to Active (Kp 3-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, has been at background levels throughout.

High energy electron flux (greater than 2MeV) as measured at GOES16, increased to mainly High levels at the diurnal maxima, peaking at 13000 pfu at 29/1645 UTC. The 24-hour integrated fluence was at Active levels and on a rising trend, with 4.0e8 integrated pfu recorded at 30/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain Low, with a chance of reaching Moderate levels

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through the coming days.

Solar Wind / Geomagnetic Activity: There have been numerous mainly faint filament eruptions appearing in coronagraph imagery over the past few days. These various CMEs have been largely directed away from Earth, but with the possibility of some glancing influence at various times throughout the forecast period. The most likely CME to glance Earth was emitted early on 29 April from near AR3288 and has been modelled, with the northern flank perhaps glancing Earth later on day 3 (2 May).

Otherwise, the fast wind from CH96/- is expected to start the period at similar levels to those currently being experienced, with the strong to elevated solar wind speeds starting to ease into Day 1 (30 Apr). A further coronal hole, CH98/-, is currently in the northwestern disc and it is possible that this feature may prolong wind speeds into Days 2 and 3 (01-02 May), before a sustained reduction.

Geomagnetic activity is expected to be Unsettled to Active, with a slight chance of isolated G1/Minor Storm intervals, both on day 1 under waning high speed stream influence, and perhaps also on day 3 due to possible glancing CME interaction. Otherwise, activity should gradually subside through the period.

Energetic Particles / Solar Radiation: Overall no solar radiation storms are expected, but there is a slight chance of a storm occurring, mainly due to the westward progression of AR3288. High energy (greater than 2MeV) electron flux at GEO is at mostly High levels, and is most likely to continue to reach High levels, especially around the diurnal maxima through the coming days. Electron fluence is currently above the Active (1e8 integrated pfu) threshold and is most likely to stay that way through the period, with an initial rising trend on day 1 (30 Apr) and perhaps into day 2 (1 May).

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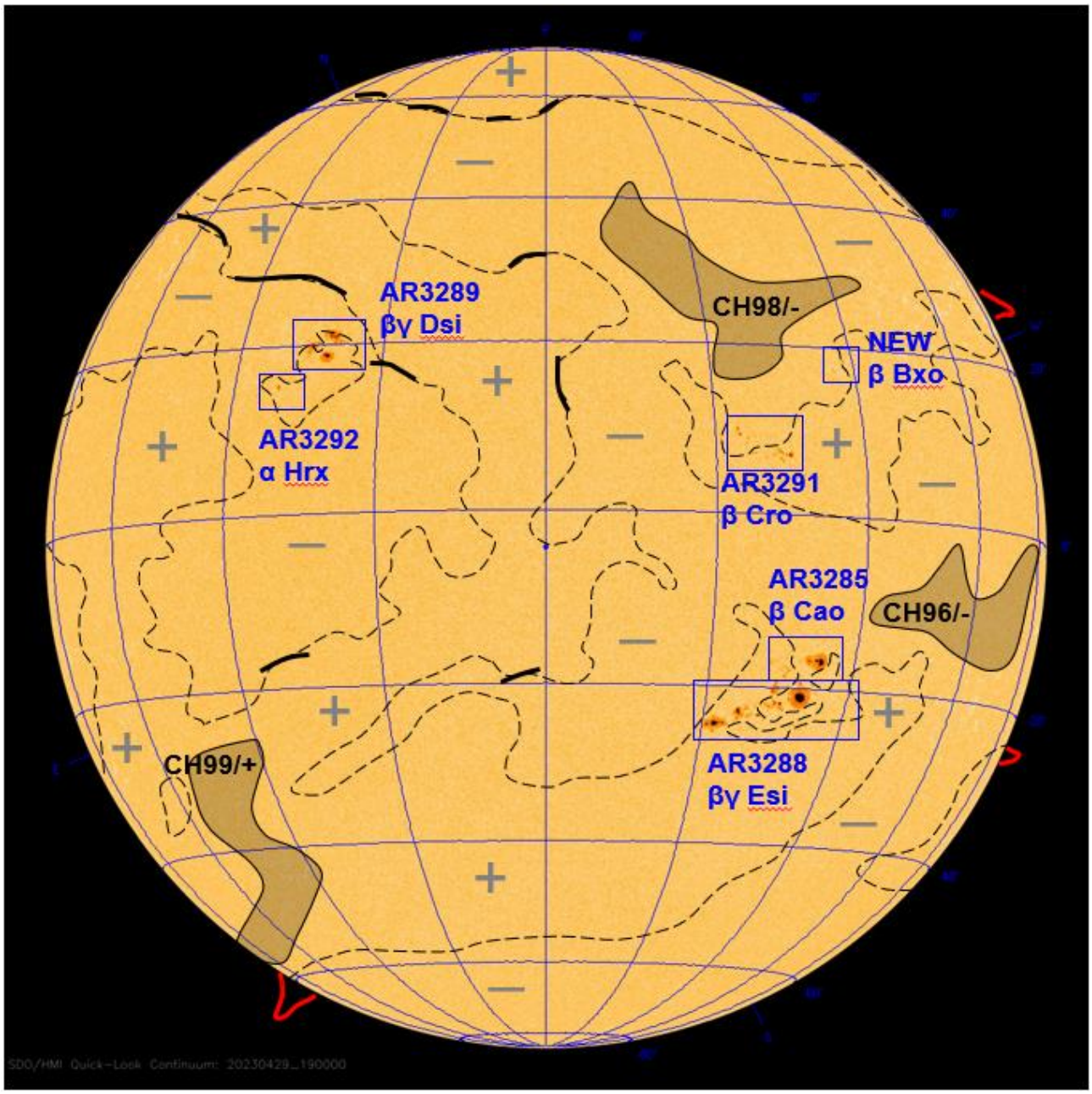
Figure 1. Solar Analysis Valid 29/1900UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There have been numerous mainly faint filament eruptions appearing in coronagraph imagery over the past few days. These various CMEs have been largely directed away from Earth, but with the possibility of some glancing influence at various times throughout the forecast period. The most likely CME to glance Earth was emitted early on 29 April from near AR3288 and has been modelled, with the northern flank perhaps glancing Earth later on day 3 (2 May). Otherwise, the fast wind from CH96/- is expected to start the period at similar levels to those currently being experienced, with the strong to elevated solar wind speeds starting to ease into Day 1 (30 Apr). A further coronal hole, CH98/-, is currently in the northwestern disc and it is possible that this feature may prolong wind speeds into Days 2 and 3 (01-02 May), before a sustained reduction.

Geomagnetic activity is expected to be Unsettled to Active, with a slight chance of isolated G1/Minor Storm intervals, both on day 1 under waning high speed stream influence, and perhaps also on day 3 due to possible glancing CME interaction. Otherwise, activity should gradually subside through the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/1002	Partial	AR3288	SW	510 km/s	02/1700UTC	Slight chance glancing influence/G1 activity.

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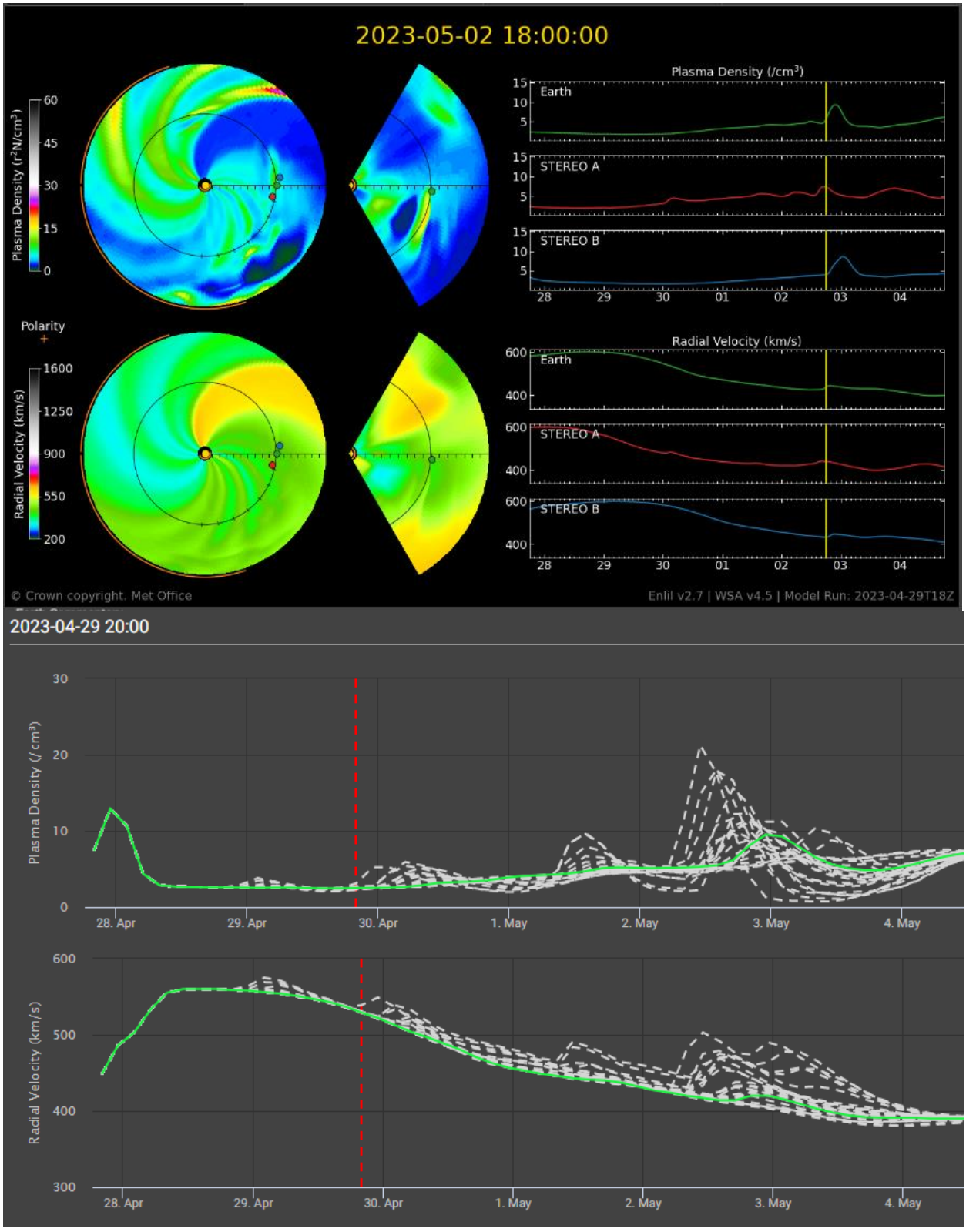
Figure 2: MOSWOC Enlil and ensemble. Ensemble shows main chance of glancing CME on 2 May.


2023-05-02 18:00:00
Plasma Density (/cm³)
Earth
STEREO A
STEREO B
Plasma Density (r²N/cm³)
Polarity
Radial Velocity (km/s)
Radial Velocity (km/s)
28 29 30 01 02 03 04
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Enlil v2.7 | WSA v4.5 | Model Run: 2023-04-29T18Z
2023-04-29 20:00
Plasma Density (/ cm³)
Radial Velocity (km/s)
28. Apr 29. Apr 30. Apr 1. May 2. May 3. May 4. May

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Radio Blackouts - X-Ray Flares:

There are currently five numbered sunspot regions on the visible disc. The largest and most complex region on the disc remains AR3288 (Eso/Beta-Gamma), located in the southwest quadrant. The previous delta configuration appears to have faded since previous analysis, however further evolution is evident in the intermediate spots. In close proximity to the north is AR3285 (Cao/Beta) which may also help to increase magnetic instability. AR3289 (Dsi/Beta-Gamma) has seen continued slight growth in its northern spots. This region has more of a north-south magnetic alignment, which could increase the instability of this group. The other two numbered regions are small and more simple at present.

Currently, there are no significant far-sided regions expected to rotate onto the disc, with none of the near sided regions due to rotate off. As such, flare risk has been kept flat through the four days with a chance of M-flares, mainly from AR3288 but also from AR3289.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

No solar radiation storms are expected, but there is a slight chance of a storm occurring over the four days due to the westward progression of AR3288.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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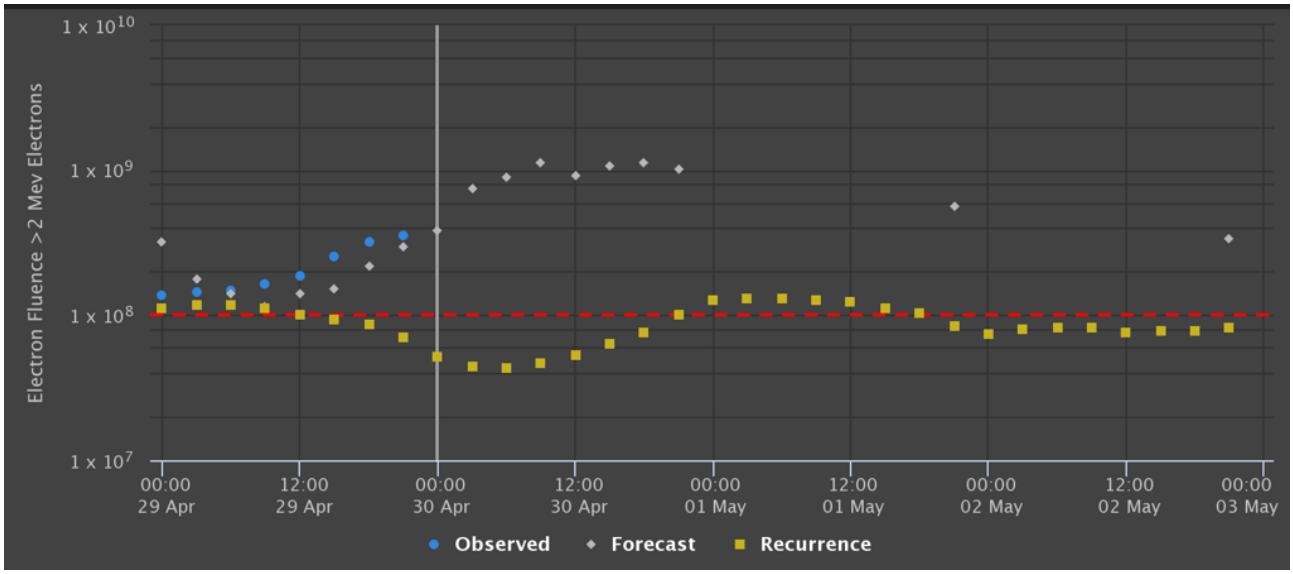
High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2MeV) electron flux at GEO is currently at High levels, and is most likely to continue to reach High levels, especially around the diurnal maxima through the coming days. As the current HSS wanes, it is likely that electron flux will initially increase further. However, on day 3 (2 May) there is a slight chance of glancing CME influence, which increases uncertainty in the forecast in the second half of the period, and could potentially lower flux levels significantly.

Electron fluence is currently above the Active (1e8 integrated pfu) threshold and is most likely to stay that way through the period, with an initial rising trend on day 1 (30 Apr) and perhaps into day 2 (1 May). MOSWOC REFM is also forecasting an above Active trend, increasing confidence in the forecast. The slight chance of any CME influence could cause a drop in fluence level however, mainly from day 3.

GEO Electron Environment	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	80	70
Very Active	≥ 2 MeV ≥ $1x10^9$	No	5	10	10	5

Figure 3: MOSWOC REFM latest output showing predicted Active fluence for the next 3 days.



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